IEEE P802.3az Wake Time Shrinkage Ad Hoc report

David Law
David_Law@3Com.com

IEEE P802.3az Wake Time Shrinkage Ad Hoc

- Ad Hoc charter

  Calculate the minimum PHY TX Wake Time shrinkage for each PHY

  Calculate the minimum PHY RX Wake Time shrinkage for each PHY

  Calculate the minimum, if any, Assert Low Power Idle times for each PHY

  Decide the minimum, if any, Wake Time that is specified for the RX System

- Agenda for calls
  - Reviewed patent slide set
  - Review contributions
  - Review calculations

THANK YOU to all that attended the calls and contributed to work !!

Review of Contributions

- 3 contributions in total
  - First conference call
    - IEEE P802.3az Proposed Wake Shrinkage Values
      Mike Grimwood, Broadcom
      - Proposed a framework for the 10GBASE-T and 1000BASE-T PHY wake-time calculations as well as summary of values
      - Assumed 10GBASE-T PHY begins to send IDLE as soon as Wake is received
    - PHY wake time shrinkage calculations for 1000BASE-T
      Adam Healey, LSI
      - Provided a framework for the 1000BASE-T PHY wake-time calculations
  - Second conference call
    - 1000BASE-T PHY worst-case wake-time budget
      Jim Barnette, Vitesse
      - Used framework in contribution above to calculate 1000BASE-T PHY worst-case wake-time values

Consensus definitions

- Transmitter ($T_{PHY\_SHRINK\_TX}$) – The difference between…
  - the delay between a transition from “Assert low power idle” to “Normal idle” at the xMII and the corresponding start of the wake signal at the MDI and…
  - the propagation delay of a start of shell delimiter from the xMII to the MDI ($T_{PHY\_PROP\_TX}$)

From ‘PHY wake time shrinkage calculations for 1000BASE-T ’, Adam Healey, Slide 2
http://www.ieee802.org/3/az/public/adhoc/shrinkage/healey_01_0209.pdf

- Receiver ($T_{PHY\_SHRINK\_RX}$) – The difference between…
  - the delay between start of the wake signal at the MDI and the corresponding transition from “Assert low power idle” to “Normal idle” at the xMII and…
  - the propagation delay of a start of shell delimiter from the MDI to xMII ($T_{PHY\_PROP\_RX}$)

From ‘PHY wake time shrinkage calculations for 1000BASE-T’, Adam Healey, Slide 2
http://www.ieee802.org/3/az/public/adhoc/shrinkage/healey_01_0209.pdf

- For 1000BASE-T the “start of the wake signal” is the start of transmission associated with entry into the WAKE_TRAINING state

From ‘PHY wake time shrinkage calculations for 1000BASE-T’, Adam Healey, Slide 4
http://www.ieee802.org/3/az/public/adhoc/shrinkage/healey_01_0209.pdf

Consensus 100BASE-T calculation

Tphy_wake_tx = TX PCS latency (T4a) + TX AFE/DSP stabilize time (T4b)
= 0.1 + 5 = 5.1 us (max)

Tphy_shrink_tx = Tphy_wake_tx - Tphy_prop_tx
= 5.1 us - TX latency (assume 0.1us based on T4a)
= 5 us (max)

Tphy_wake_rx = RX signal_detect assert time (T3a)
+ RX AFE stabilize time (T3b)
+ RX DSP/clock retrain time (T3c)
+ RX PCS descrambling time (T3d)
= 5 + 5+ 5 + 0.5 = 15.5us (max)

Tphy_shrink_rx = Tphy_wake_rx - Tphy_prop_rx
= 15.5 us - TX latency (assume 0.5us based on T3d)
= 15 us (max)

Tw_sys_tx = Tw_sys_rx + Tphy_shrink_tx + Tphy_shrink_rx
= Tw_sys_rx + 5 + 15
= Tw_sys_rx + 20us

Tw_phy = Tphy_wake (min) + Tphy_shrink_tx
= 15.5 + 5 = 20.5us

From 'IEEE P802.3az Wait time (Tw) from a system design perspective', David Law, Slide 11
http://www.ieee802.org/3/az/public/jan09/law_1_0109_V3_0.pdf

Consensus 1000BASE-T calculation (page 1 of 2)

Symbol	Description	Min.	Max.	Units	Notes
Specified values					
T_{TDP}	Transmit GMII to MDI latency		84	ns	Alias for $T_{PHY\_PROP\_TX}$
T_{RDP}	Receive MDI to GMII latency		244	ns	Alias for $T_{PHY\_PROP\_RX}$
T_{M}	Media propagation delay		550	ns	
T_{TA}	Transmitter activation time		700	ns	
T_{SA}	Signal detect assertion time		500	ns	
T_{WTX}	Corresponds to lpi_waketx_timer	1200	1400	ns	
T_{MZ}	Corresponds to lpi_wakemz_timer		5000	ns	
T_{W}	PHY wake time		16000	ns	Alias for T_{W_PHY}
For timing budget purposes only					
T_{TCP}	Transmit latency for encoded variables		84	ns	
T_{RCP}	Receive latency for encoded variables		244	ns	
T_{SCR}	SLAVE scrambler acquisition time		TBD	ns	
T_{RCVR}	MASTER receiver acquisition time		TBD	ns	
Derived parameters					
T_{SZ}	SLAVE WAKE to WAKE_TRAINING time		TBD	ns	

From ‘PHY wake time shrinkage calculations for 1000BASE-T’, Adam Healey, Slide 5
http://www.ieee802.org/3/az/public/adhoc/shrinkage/healey_01_0209.pdf

Consensus 1000BASE-T calculation (page 2 of 2)

- $T_{SZ} \leq (T_{TA} + T_M + T_{SA}) + T_{MZ} + (T_{TCP} + T_M + T_{RCP}) + T_{SCR}$
- $T_{TWTS}(M) \leq T_{MZ} + (T_{TCP} - T_{TDP})$
- $T_{TWTS}(S) \leq T_{SZ} + (T_{TCP} - T_{TDP})$
- $T_{RWTS}(M) \leq T_{RCVR} + (T_{RCP} - T_{RDP})$
- $T_{RWTS}(S) \leq T_{RCP} + T_{SCR} + 2(T_{TCP} + T_M + T_{RCP}) + T_{RCVR} - T_{RDP}$
  $\leq T_W - T_{TWTS}(M) - T_{WSR}(M) = T_{TWTS}(S) - T_{TWTS}(M) + T_{RWTS}(M)$

From 'PHY wake time shrinkage calculations for 1000BASE-T', Adam Healey, Slide 9
http://www.ieee802.org/3/az/public/adhoc/shrinkage/healey_02_0309.pdf

Consensus 10GBASE-T calculation (page 1 of 2)

Case 1 – Wake during SLEEP condition

Tphy_wake_tx = Tphy_prop_tx + lpi_tx_sleep_timer + lpi_tx_alert_timer
= Tphy_prop_tx + 10 LDPC frames + 4 LDPC frames
= Tphy_prop_tx + 3.20us + 1.28us
= Tphy_prop_tx + 4.48 us

Tphy_shrink_tx = Tphy_wake_tx - Tphy_prop_tx
= Tphy_prop_tx + 4.48 us - Tphy_prop_tx
= 4.48 us

Tphy_wake_rx = Tphy_prop_rx

Tphy_shrink_rx = Tphy_wake_rx - Tphy_prop_rx
= 0us

Tw_phy = Tphy_wake + Tphy_shrink_tx
= 2.88 us + 4.48 us (lpi_tx_wake_timer 9 LDPC frames max)
= 7.36 us

NOTE: Tphy_shrink_rx computation assumes that the receive PHY begins to send IDLE as soon as Wake is received.
Otherwise Tphy_shrink_rx = lpi_tx_wake_timer = 2.88 us

From 'IEEE P802.3az Proposed Wake Shrinkage Values', Mike Grimwood, Slide 7
http://www.ieee802.org/3/az/public/adhoc/shrinkage/grimwood_01_0209.pdf

Consensus 10GBASE-T calculation (page 2 of 2)

Case 2 – Wake after SLEEP condition

- Tphy_wake_tx = Tphy_prop_tx + lpi_tx_alert_timer + 1 LDPC frame
  = Tphy_prop_tx + 4 LDPC frames + 1 LDPC frame
  = Tphy_prop_tx + 1.6 us
- Tphy_shrink_tx = Tphy_wake_tx – Tphy_prop_tx
  = 1.6 us

- Tphy_wake_rx = Tphy_prop_rx
- Tphy_shrink_rx = Tphy_wake_rx – Tphy_prop_rx
  = 0 usec

- Tw_phy = Tphy_wake + Tphy_shrink_tx
  = 9 LDPC frames + 1.6 us
  = 4.48 us

NOTE: Tphy_shrink_rx computation assumes that the receive PHY begins to send IDLE as soon as Wake is received. Otherwise Tphy_shrink_rx = lpi_tx_wake_timer = 2.88 us

From 'IEEE P802.3az Proposed Wake Shrinkage Values', Mike Grimwood, Slide 9
http://www.ieee802.org/3/az/public/adhoc/shrinkage/grimwood_01_0209.pdf

Other consensus items

- Global Minimum Low Power Idle assert duration specification not required
  - Provide two sets of wake times for the two 10GBASE-T case (wake during or after SLEEP)
- Wake Time specified for RX System
  - For 1000BASE-T and 10GBASE-T provided by PHY sending IDLE as soon as Wake is received
    - Requires change 10GBASE-T EEE PHY in draft so that begins to send IDLE as soon as Wake is received

Consensus values

PHY type	Tw_sys_res Default (min)	Tw_phy (min)	Tphy_shrink_tx (max)	Tphy_shrink_rx (max)	Tw_sys_rx default (min)
100BASE-T	30 us	20.5 us	5 us	15 us	10 us
1000BASE-T	TBD	TBD	TBD	TBD	TBD
Case 1 10GBASE-T	7.36 us	7.36 us	4.48 us	0 us	2.88 us
Case 2	4.48 us	4.48 us	1.6 us	0 us	2.88 us

Note 1 – 10GBASE-T calculation assumes early IDLE detection in Wake

Summary and motion

- The wake time Ad Hoc reached consensus on all items with the exception of the two parameters required to define the 1000BASE-T wake time
- The Backplane PHYs are yet to be addressed

Motion:

The IEEE P802.3az Task Force adopts the wake time related definitions on slide 4, the wake time equations on slides 5 through 9 and the wake time values on slide 11 of law_1_0309.pdf

Definitions from slide 4 should appear in subclause 78.2.3. The values from slide 11 should appear in Table 78-4.

Move: David Law

Second: George Zimmerman

Y: 20 N: 0 A: 3

Motion PASSES

Aggregate attendance

Hugh Barrass	Cisco	Gavin Parnaby	Solarflare
Jim Barnette	Vitesse	Velu Pillai	Broadcom
Mike Bennett	LBNL	Bob Thelen	Avago
Brad Booth	AMCC	Geoff Thompson	Nortel
Noel Butler	LSI	Jacobo Riesco	LSI
Mandeep Chadha	Vitesse	Jeff Slavick	Avago
Joseph Chou	Realtek		
Wael William Diab	Broadcom		
Niall Fitzgerald	LSI		
John Fuller			
Mike Grimwood	Broadcom		
Adam Healey	LSI		
Rita Horner	Avago		
David Law	3Com		
Shimon Muller	Sun Microsystems		